

1 **INVESTIGATION BY THE**
2 **MASSACHUSETTES DEPARTMENT OF PUBLIC UTILITIES**
3 **ON ITS OWN MOTION INTO THE PREPARATION AND RESPONSE OF**
4 **FITCHBURG GAS & ELECTRIC COMPANY D/B/A UNITIL TO**
5 **THE DECEMBER 12, 2008 WINTER STORM**

6
7 **D.P.U. 09-01-A**

8
9 **Prepared Direct Testimony of**

10
11 **Richard E. Brown**

12 **On Behalf of Attorney General of the Commonwealth of Massachusetts**

13
14 **BEFORE THE DEPARTMENT OF PUBLIC UTILITIES**

15
16 **March 25, 2009**
17

1 **I. INTRODUCTION**

2

3 **Q. Please state your name and business address.**

4 A. My name is Richard E. Brown. My business address is Quanta Technology, 4020
5 Westchase Blvd., Suite 300, Raleigh, NC, 27607. My business phone number is
6 919-334-3021.

7

8 **Q. By whom are you employed and what is your position?**

9 A. My employer is Quanta Technology LLC, where I am the Senior Vice President
10 of Operations. Quanta Technology is a consulting firm providing independent
11 technical and management consulting services, primarily to the electric power in-
12 dustry. Quanta Technology is wholly-owned by Quanta Services, a large utility
13 services holding company.

14

15 **Q. Please describe your educational background and business experience.**

16 A. I received a BSEE, MSEE, and PhD degree from the University of Washington
17 (Seattle, WA) in 1991, 1993, and 1996, respectively. I received an MBA from the
18 University of North Carolina (Chapel Hill, NC) in 2003.

1 From 1991 to 1993 I worked as an Electrical Engineer at Sverdrup Corporation
2 (now Jacobs Engineering) performing design work for electric distribution sys-
3 tems. Responsibilities included engineering design of medium voltage and low
4 voltage electrical systems for industrial facilities, institutional facilities, and pub-
5 lic works. Typical work included design, value engineering, specification writing,
6 construction document generation, and construction support.

7
8 From 1994 to 1996 I worked as a teaching and research assistant for the Univer-
9 sity of Washington while attending graduate school. My research was in the area
10 of distribution system reliability assessment, storm reliability, and design optimi-
11 zation. In addition to research, I served as a teaching assistant for various power
12 systems and controls courses at the undergraduate and graduate level.

13
14 From 1996 to 2003 I worked for ABB in various roles. From 1996 to 1999 I was a
15 Senior Engineer in the corporate research department with responsibilities of re-
16 search, product development, consulting, and project management. From 1999 to
17 2001 I was a Principal Engineer for the Distribution Solutions group with the goal
18 of providing customers with complete solutions based on functional requirements
19 including design, build, own, operate, maintain, and finance. From 2001 to 2003 I

1 was the Director of Technology for the Consulting business with the responsibil-
2 ity for research and development of algorithms and software tools.

3
4 From May of 2003 through June 2006, I was a Senior Principal Consultant for
5 KEMA. As a charter member of the T&D Consulting division in the US, my role
6 was to provide management and technical consulting services in the areas of dis-
7 tribution reliability, asset management, and storm performance.

8
9 I have been with Quanta Technology from July 2007 through the present. As a
10 charter member, I was responsible for growing the distribution business area,
11 which includes planning, engineering, reliability, asset management, and storm
12 performance. Since November 2008, I have assumed operational responsibility
13 for the overall company while still providing consulting services to clients.

14
15 From June 2008 through the present, I have served as an Adjunct Professor for
16 North Carolina State University.

17
18 I have authored or co-authored more than ninety technical papers and articles on
19 the topics of distribution reliability, asset management, and storm performance. I
20 am also author of the book *Electric Power Distribution Reliability* (Second Edi-

1 tion, CRC Press, 2009), and have contributed to the book *Electric Power Substa-*
2 *tion Engineering* (Second Edition, CRC Press, 2007), and the book *The Electric*
3 *Power Engineering Handbook* (CRC Press, 2001). I am a Fellow of the Institute
4 for Electrical and Electronics Engineers (IEEE), which is conferred by the IEEE
5 Board of Directors for an extraordinary record of industry accomplishments. I am
6 registered by the state of North Carolina as a Professional Engineer.

7
8 **Q. Are you sponsoring an exhibit in this case?**

9 A. No.

10
11 **Q. What is the purpose of your testimony?**

12 A. The Department of Public Utilities (Department or DPU) opened this investiga-
13 tion on January 7, 2009 to review how the four electric distribution companies
14 prepared for and implemented emergency restoration plans for the ice storm that
15 began on December 11, 2008 (2008 Ice Storm). On March 3, 2009, the Hearing
16 Examiner established a schedule calling for formal testimony and hearings for
17 that portion of this investigation relating to the performance of Fitchburg Gas and
18 Electric (FG&E). As a result, my testimony is focused on the performance of
19 FG&E.

1 The purpose of my testimony is to present an analysis of the technical aspects of
2 Fitchburg Gas & Electric (FG&E) as they relate to the damage and restoration as-
3 sociated with the 2008 Ice Storm. FG&E is owned by Unitil. Additional aspects
4 of the performance of FG&E are examined by Ms. Alexander on behalf of the At-
5 torney General.

6 7 **II. ANALYSIS AND FINDINGS**

8
9 **Q. Please briefly describe the basis of your analysis.**

10 A. My analysis is based on the responses of Unitil to the following document and
11 information requests to FG&E: the first set of requests by the DPU; the first set of
12 requests by the Attorney General; and the second set of requests by the Attorney
13 General. I also reviewed the transcripts of the public hearings held in Fitchburg on
14 January 27, 2009, and the transcripts of the public hearings held in Lunenburg on
15 February 3, 2009.

16
17 It is my understanding that in my Rebuttal Testimony I will be able to add my re-
18 view of Unitil's forthcoming assessment on the 2008 Ice Storm by its own con-
19 sultant and managers that will be filed on March 25, 2009 as well as finalize my
20 remarks and my conclusions herein.

1

2 **Q. Did insufficient vegetation management on the transmission system contrib-**
3 **ute significantly to ice storm damage?**

4 A. No. A certain amount of transmission system damage is expected during ice
5 storms. Unitil performs side trimming on its transmission system on a five-year
6 cycle, and has associated vegetation management practices that correspond to
7 standard industry practice (Operations Bulletin #OP5.00, Feb. 1, 2007). This as-
8 sessment is based on the documented Unitil processes. A field assessment of ac-
9 tual transmission vegetation conditions has not been performed.

10

11 **Q. Did insufficient vegetation management on the distribution system contribute**
12 **significantly to ice storm damage?**

13 A. Yes. A certain amount of distribution system damage is expected during ice
14 storms. Maintaining clearances between power lines and vegetation will not pre-
15 vent trees from falling over during ice storms. Unitil states in AG 1-43, "...
16 weather related outages are primarily caused by tree damage and related impacts
17 on the electric system, not due to a deficiency in the withstand capability of
18 equipment. This was particularly true during the 2008 Ice Storm when virtually
19 all damage to the electric system resulted from trees, and portions of trees, falling
20 on overhead electric lines."

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Prevention of this failure mode is primarily accomplished by removing dead, diseased, or otherwise hazardous trees (hazard trees). Unitil’s distribution vegetation management consists of both clearance trimming to keep vegetation away from conductors and hazard tree removal. Clearances must be maintained to ensure public safety. Therefore, insufficient vegetation management budgets result in utilities struggling to maintain their trimming cycles and associated clearances. This results in a reduced ability to sufficiently focus on hazard trees, resulting in more damage during ice storms.

On Feb. 8, 2007, a Unitil focus group concluded (AG 1-1, Attachment 1), “Since 2002, none of the operating companies have been able to trim the required number of sections with the current funding levels. At the end of 2006, the DOCs are a combined 612 miles or 2.2 years behind schedule. It is projected that the DOCs will be 3.5 years behind schedule at the end of the existing 8 year schedule. In addition to being behind schedule, the current funding is not proving to be enough to support the quantity of trimming required to maintain the schedule. At the present production levels, the DOC trimming budget is under funded by \$601k.”

1 To address insufficient vegetation budgets, Unitil adjusted clearance standards
2 and vegetation management cycles rather than significantly increasing vegetation
3 management budgets. On distribution vegetation management, FG&E spent
4 \$361,290 in 2006, \$352,823 in 2007, and \$330,195 in 2008 (AG 1-1, Attachment
5 1). This trend in budget reductions will result in continued difficulties in achiev-
6 ing adequate clearances and an increased difficulty to place sufficient focus and
7 effort on hazard tree removal.

8
9 **Q. Did customer participation issues related to hazard tree removal contribute**
10 **significantly to ice storm damage?**

11 A. Yes. It is inferred from the Unitil vegetation management policy (Operations Bul-
12 letin #OP5.00, Feb. 1, 2007), that (1) a customer can refuse to allow Unitil to re-
13 move a hazard tree located on the customer's property, and (2) the customer is re-
14 quired to reimburse Unitil for the removal of a hazard tree located on the cus-
15 tomer's property. Unitil is constrained by regulations and city ordinances with re-
16 gards to these issues. However, both of the above constraints inhibits the ability of
17 Unitil to remove hazard trees, and therefore result in increased damage during ice
18 storms. Future ice storm damage could be reduced by (1) allowing Unitil to con-
19 demn dead and diseased trees on customer property, and (2) allowing Unitil to

1 remove hazard trees at its own expense and capitalize these costs in the rate base
2 as a permanent property improvement.

3
4 **Q. Did distribution trimming standards contribute significantly to ice storm**
5 **damage?**

6 A. Yes. The Unitil trimming standard (Operations Bulletin #OP5.00, Feb. 1, 2007)
7 specifies under trimming, which allows for tree branches to exist directly over
8 conductors as long as there is a large enough physical separation. Although many
9 municipalities require this type of trimming for aesthetic reasons, it results in high
10 trimming costs and lower reliability when compared to “ground-to-sky” trimming
11 that does not allow branches to overhang conductors. This is especially true dur-
12 ing ice storms, when ice buildup will cause overhanging branches to break and
13 fall into the conductors.

14
15 **Q. Did insufficient inspection and maintenance on the transmission system con-**
16 **tribute significantly to ice storm damage?**

17 A. No. Unitil transmission inspection and maintenance practices (Operations Bulletin
18 #OP2.00, Dec. 1, 2000) are in accordance with standard industry practice. This
19 assessment did not look at Unitil’s work backlog in this area nor did it examine
20 actual conditions in the field.

1

2 **Q. Did insufficient inspection and maintenance on the distribution system con-**
3 **tribute significantly to ice storm damage?**

4 A. No. Unitil attempts to inspect for strength deterioration on its wood poles on a
5 ten-year cycle, which is standard industry practice. The Unitil procedures for de-
6 tecting deterioration are sufficient. While performing these wood pole inspec-
7 tions, Unitil also inspects for other potential problems at this time. These addi-
8 tional inspections will reduce storm damage as long as identified problems are
9 corrected.

10

11 Unitil states in its response to AG 1-38, “Inspections of transmission and distribu-
12 tion wood poles and pole mounted equipment occur on a ten year cycle; meaning
13 one tenth of the system is inspected annually. Poles are visually inspected and
14 tested at and below grade level to determine the soundness of the wood. Pole
15 mounted equipment such as insulators, grounds, transformers, reclosers, switches,
16 cutouts, and guys are visually inspected at the time of pole testing.”

17

18 In 2007 and 2008, FG&E did not meet its goal of inspecting 10% of distribution
19 poles. According to DPU 1-14, Table 11-7, it can be calculated that FG&E only
20 inspected 8.5% in 2007 and 5.1% in 2008. This table also shows 47 condemned

1 poles, which is 0.27% of all poles. Only one condemned pole failed during the
2 2008 Ice Storm.

3
4 There were 244 damaged and/or replaced poles during the 2008 Ice Storm (DPU
5 1-10 Table 8). This is 1.25% of the total pole population of 19,573 (DPU 1-14,
6 Table 11-7). This pole failure rate is not indicative of a widespread wood pole de-
7 terioration problem.

8
9 DPU 1-10 Table 8 does not have the installation date for many of the listed poles.
10 For those with installation dates, the mean age of failed poles is 63 years. DPU 1-
11 10 Table 8 also does not have the installation date for many of the listed poles.
12 Based on the poles with listed installation dates, the mean age of the entire pole
13 population is 73 years. Therefore, older poles did not tend to fail more frequently
14 during the 2008 Ice Storm. Since wood poles deteriorate and lose strength with
15 age, this is also indicative that widespread wood pole deterioration is not a prob-
16 lem.

17
18 DPU 1-10 Table 8 does not have the most recent inspection dates for most of the
19 failed poles. Inspection dates for inspections that occurred before 2007 are not
20 available. The data provided indicated that 21 failed poles were inspected in 2008

1 and 38 poles were inspected in 2007. This could indicate that less-recently in-
2 spected poles are more prone to failures, but further analysis would be required to
3 confirm or reject this hypothesis.

4
5 DPU 1-10 Table 8 shows one pole that was inspected in 2009. This is clearly a
6 data error since the failure occurred in 2008.

7
8 This assessment did not examine the field conditions of the FG&E distribution
9 system. It also did not examine inspector qualifications and training.

10
11 **Q. Did insufficient inventory and logistics management contribute significantly**
12 **to long restoration times?**

13 A. No. Unitil keeps a 60-day supply of inventory (AG 1-36), which is standard in-
14 dustry practice. Unitil reports that initial inventory levels and procurement during
15 the storm resulted in sufficient materials and did not slow down the restoration
16 process. In a December 19, 2008 internal email, Mark Lambert writes (AG 1-62
17 Attachment 2), "IN ALL HONESTY, we have more supplies than we know what
18 to do with. We will actually have to evaluate at the end of the storm whether we
19 should be carrying that additional inventory of whether we should send it back."

1 **Q. Did insufficient emergency response systems and processes contribute sig-**
2 **nificantly to long restoration times?**

3 A. Yes. Unitil has outlined the various systems that are used in field operations and
4 customer service and how they are applied during emergency restoration opera-
5 tions. The processes Unitil follows during emergency response are contained in its
6 Emergency Restoration Plan (ERP) and are referenced throughout Unitil's storm
7 report.

8
9 Overall, the Unitil restoration processes as outlined in the ERP are general and do
10 not define specific activities at specific times or sequences as part of an overall
11 restoration effort. Because Unitil is a small utility, it is not unusual to see proc-
12 esses with less definition than in larger utilities. The reasoning behind this is that
13 operations can be managed through internal communication and cooperation that
14 result from a small organization and a single operations center. In the case of av-
15 erage or routine storm responses, a lack of specificity in an ERP will work. Defi-
16 ciencies in systems or processes are often overcome by manual effort; in small
17 restoration operations, this presents no problem.

18
19 However, the 2008 Ice Storm demonstrates the need for well-defined processes,
20 roles, responsibilities, sequenced steps to prepare for oncoming storms, and man-

1 agement of external resources during a large restoration effort. The Until ERP is
2 lacking in this regard.

3

4 **Q. Did insufficient emergency response drills and exercises contribute signifi-**
5 **cantly to long restoration times?**

6 A. Yes. It is not possible to execute emergency processes during a major event with
7 maximum proficiency without regular drills and exercises. When a major storm
8 strikes, it is not the time for on-the-job training. Until states in AG 1-29, “The
9 Restoration Plan Review Committee holds an annual meeting ... The Emergency
10 Restoration Plan is reviewed ... If training needs are identified, subsequent train-
11 ing is scheduled.” This type of periodic management review is necessary but in-
12 sufficient for preparing a utility for an efficient response to major events. Emer-
13 gency restoration plans should be drilled on at least an annual basis. This is a
14 common practice in the utility industry and should be part of an emergency resto-
15 ration process.

16

17 **Q. Did a lack of pre-storm event planning hinder Until’s response and restora-**
18 **tion effort?**

19 A. Yes. As stated in Until’s report, the implementation of their emergency restora-
20 tion plan was declared at “Full Implementation” level following significant out-

1 ages resulting from the 2008 Ice Storm. The earlier stages of the plan, “Monitor-
2 ing” and “Standby” levels, were not implemented in anticipation of a major storm
3 event. Unitil did contact employees and their on-system contractors to alert them
4 to potential storm conditions. However, the company did not take action to secure
5 commitments for additional resources in the period between issuance of weather
6 warnings for a major ice event and the actual onset of the storm. Good utility
7 practice includes having processes in place to secure outside resource commit-
8 ments prior to storm outages occurring. In some cases, utilities will have re-
9 sources pre-staged in nearby locations for immediate response to storm damage.
10 A comprehensive pre-storm planning process also provides for thorough logistical
11 planning to accommodate the needs of additional resources on the property. It is
12 unclear within the management structure of Unitil what authority exists for the
13 Emergency Restoration Manager to acquire outside resources and the timeframe
14 in advance of a storm that such decisions can be made.

15
16 It is not clear in the Emergency Restoration Plan what decision process is fol-
17 lowed during the days and hours prior to the occurrence of storm damage. Unitil
18 states in AG 1-25, “Unitil does not perform detailed pre-storm planning activities
19 based on set 120, 96, 72, or 48 hour intervals.” Without these types of checklists,
20 the timeline and scope of Unitil’s pre-storm planning process is ad hoc and sub-

1 ject to heat-of-the-moment decisions that have not been tested through compre-
2 hensive drills.

3
4 **Q. Did the lack of an outage management system contribute significantly to long**
5 **restoration times?**

6 A. Yes. In storm response evaluations, much attention is paid to the use or lack of
7 use of an Outage Management System (OMS). An outage management system is
8 designed to report the location of outages, the number of customers affected, the
9 suspected line device that has operated to clear a line fault, to track the status of
10 outages on the system, and to generally improve outage restoration efficiency. As
11 such, if Unitil had an OMS that was properly integrated into its customer service
12 system and workforce management system, more accurate information would
13 have been available for use in restoration and customer communications.

14
15 While an OMS alone could not have prevented a lengthy restoration period, par-
16 ticularly because the damage was so widespread, it certainly hindered efficient
17 restoration activities once the main distribution feeder trunks were restored and
18 restoration efforts become based on trouble tickets. Unitil confirms this assess-
19 ment in AG 1-47 when it states, “Trouble tickets become most useful in major
20 outages when the restoration effort is focused on individual services, after primary

1 and secondary lines have been repaired. Outages by circuit were used during the
2 2008 Ice Storm to prioritize circuit repairs in accordance with the restoration ap-
3 proach to bring as many customers back on line as fast as possible.”

4

5 Most investor-owned utilities in the U.S. have an OMS. Prior to the 2008 Ice
6 Storm, FG&E had and is still considering the purchase of an outage management
7 system.

8

9 Lack of an OMS limited the ability of FG&E to determine accurately the number
10 of customers that remained without electrical service during restoration efforts.

11 During the 2008 Ice Storm, FG&E used electronic maps from its geographic in-
12 formation system to estimate the number of interrupted customers (AG 1-32).

13 There is no way to verify whether these estimates are close to actual values.

14

15 **Q. Did insufficient switching capability contribute significantly to long restora-**
16 **tion times?**

17 A. Yes. In DPU 1-14, Table 11-1, Unitil reports having 100 sectionalizing switches
18 on its primary distribution circuits. This amounts to one switch for about every
19 five circuit miles of primary circuit. It also corresponds to about 2.8 switches per
20 circuit. Both of these values are low by industry standards, and result in a reduced

1 ability for FG&E to isolate damage, reconfigure its system, and flexibly restore
2 customers during the restoration process.
3

4 **Q. Did an insufficient initial damage assessment contribute significantly to long**
5 **restoration times?**

6 A. Yes. FG&E consistently communicated overly-optimistic restoration times to its
7 customers. It can be concluded that FG&E did not have a sufficient understanding
8 of the damage on its system or the ability to determine the amount of manpower
9 required to repair its system and restore customers. If reasonably accurate damage
10 and manpower estimates are not available, it is impossible to efficiently schedule
11 resources during a major restoration effort.
12

13 Consider Unitil's initial request for utility crews (DPU 09-1-A, page 45). On De-
14 cember 11, Unitil requested thirty bucket crews. On December 12, Unitil in-
15 creased this request to forty bucket crews. Only twenty of the forty turned out to
16 be available. Based on AG 1-2, restoration required a total of 1,058 crew days
17 (not including tree crews). Assuming that (1) starting on December 13, Unitil had
18 20 additional crews each day, and (2) National Grid crews did not arrive late in
19 the restoration process, it would have taken Unitil until December 28 to restore all
20 of its customers. That is, the Unitil initial assessment of crew requirements corre-

1 sponded to a 17-day restoration period. Unitil should have known that it needed
2 many more than 40 additional crews in order to restore its customers in a reason-
3 able amount of time.

4
5 In AG 1-49, Unitil states, “Field notes from damage assessors are captured by
6 marking up circuit maps and collecting critical information such as broken poles,
7 damaged equipment and downed wires. Damage assessors also provide handwrit-
8 ten notes. This information is reviewed and organized in the nighttime hours
9 when most repair crews are resting. Estimated repair times are calculated and
10 work is prioritized based on the ratio of the number of customers without power
11 per circuit to the estimated number of crew hours of repair time.” Based on this
12 statement, it is clear that Unitil estimates repair times for identified damage. It is
13 also clear from Unitil’s inaccurate restoration estimates and insufficient initial
14 crew requests that this process does not work well after a major storm.

15
16 **Q. Did insufficient actions for obtaining foreign crews contribute significantly to**
17 **long restoration times?**

18 A. Yes. Unitil relies primarily on the New England Mutual Aid Group (NEMAG) to
19 provide crews for post-storm emergency response. Unitil states in AG 1-51, “Uni-
20 til can also contact other utilities and contractors outside of the NEMAG process,

1 if additional outside crews are still needed after the first two avenues are pursued.
2 Unitil does not currently have any executed agreements for stand-by service (out-
3 side of the NEMAG process) with crew contractor firms.”
4

5 With respect to crews, Unitil was clearly unprepared for a large region-wide event
6 that affects most of the NEMAG members. This type of event is foreseeable and
7 should be addressed in the Unitil emergency planning process. Even though the
8 option is clearly stated in its processes, Unitil did not contact any large national
9 utility contractors to request crews. It does not matter that Unitil did not have any
10 pre-existing executed agreements, since standard contracts can be negotiated and
11 signed in two hours or less. I checked with one large utility contractor who said
12 that its company could have easily delivered 80 crews to Unitil (80 bucket trucks
13 and 160 linemen) within 24 to 36 hours. This is the first contractor that I called,
14 and there are many others. All Unitil had to do to secure many more crews earlier
15 in the restoration process was to make a few simple phone calls. A more proactive
16 approach would have included making those phone calls to secure resources in the
17 days in advance of the storm.
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III. CONCLUSIONS

Q. Please summarize any conclusions that can be made based on your analysis.

A. The 2008 Ice Storm caused extensive and widespread damage to the FG&E system. This amount of damage was expected due to the nature of this storm. Damage was not unduly high due to any deficiencies Unitil may or may not have in its inspection and maintenance processes. However, Unitil's underfunded vegetation management program likely results in more hazard trees and therefore more damage during ice storms. Ice storm damage could also be reduced by eliminating the practice of under trimming.

There are a variety of factors, when combined, resulted in a protracted restoration process and unduly long customer interruption durations. This includes insufficient emergency response systems, insufficient emergency response drills, a lack of pre-storm event planning, the lack of an outage management system, poor damage and manpower estimation, and insufficient switching flexibility.

1 The biggest contribution to long restoration times were insufficient crews early in
2 the restoration process. The lack of sufficient crews was avoidable since contrac-
3 tor crews were available. Unitil simply did not attempt to contact these resources.

4

5 **Q. Does this conclude your direct testimony?**

6 A. Yes.

7